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The impact of large-scale winds on thermally driven flows and exchange processes over mountainous terrain

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In the convective boundary layer over mountainous regions, the mean values and the fluxes of quantities like heat, mass, and momentum are strongly influenced by thermally induced flows. Several studies have pointed out that the enhanced warming of the air inside a valley can be explained by the valley-volume effect whereas the cross-valley circulation leads to a net export of heat to the free atmosphere. We are interested in the influence of an upper-level wind on the local circulations and the boundary-layer properties, both locally and in terms of the horizontal mean, as this aspect has not yet received much attention. LES are carried out over idealized, two-dimensional topographies using the CM1 numerical model. For the analysis, turbulent, mean-circulation, and large-scale contributions are systematically distinguished. Also, budget analyses are performed for the turbulence kinetic energy and the turbulent heat and mass flux. Based on the first results for periodic topographies, no crucial influence on the horizontally averaged heat-flux and temperature profile can be observed, even though the flow pattern of the thermal wind is qualitatively changed. In addition to that, the impact on moisture transport will be evaluated and simulations over different topographies as well as for different atmospheric conditions and surface properties will be presented.